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From: Aviation Maintenance Human Factors Program Manager, AAR-100
To: Aircraft Maintenance TCRG (POC: Jean Watson, AFS-300)

Subj: Development of an Industry Standardized Auditing/Surveillance Tool to Eliminate Maintenance Errors Prior to Dispatch By Airlines, Air Cargo Operators, Repair Stations, and for use by Manufacturers Before Release of Aircraft to Customers

Ref: (a) Aircraft Maintenance TCRG recommendation (01/22/03)
(b) Certification Process Study

1. Research Objectives: (1) identify an exhaustive list of impact variables that affect aviation safety and transcend across various aircraft maintenance organizations; (2) develop data collection/reduction and analysis protocol to analyze errors for the identified set of impact variables; and (3) using the results of the aforementioned activity develop and implement a surveillance/monitoring tool to ensure all appropriate data is used to identify safety improvements in the maintenance environment.

   It is anticipated that the accomplishment of the above objectives will yield a system that may promote a standardized format for data collection, data reduction, trend analysis and eventually risk assessment. Initially, the system will assist in identifying contributing factors of improper maintenance. The development of the risk component of tool will allow for its use by aircraft manufacturers. The prototype tool will be developed and evaluated in cooperation with an industry partner and will be made available to the entire aircraft maintenance community for implementation. The project will be executed using the Software Life Cycle Development methodology that integrates a task analytic and a user centered methodology (early focus on users and tasks, empirical measurements and iterative design). The three-year approach will be as follows:

2. Project Execution

   a. Year I: Identification of Impact Variables and Data Sources
      i. Kick-off Meeting of Subject Mater Experts to outline the project's objectives, goals, and milestones. This step will develop a clearly

articulated development process, which acts as a master plan that defines the role of each participant on the development team. The work will be done in collaboration with Fed Express team in Memphis.

ii. The first step will identify and develop an exhaustive list of "impact variables" that could potentially impact flight safety. The initial work conducted by the industry partner provides a good starting point.

iii. Ensure that the variables identified are appropriate and representative of those used by other maintenance entities. This will be done by working with other representative maintenance entities (e.g., airlines, third party repair station).

iv. Discuss with panel of subject matter experts to develop a consensus on the list of impact variables.

v. Identify the limitations in using the specific variables and data sources that facilitate collection of error data related to the specific variables. [The focus is based on characterization of data that looks at the following typical dimensions – for example quality of content (granularity, comprehensiveness, essentialness, flexibility, etc); quality of values (currency, timeliness, completeness of values, internal and external consistency, etc); quality of format (usability, comprehensibility, precision, etc); availability (accessibility, storage, protocol/collection procedures, etc.) and architecture] Discussions will be conducted with subject matter experts on appropriateness on the use of specific data sources.

vi. Finalize the list of impact variables and data sources identifying the limitations and protocol in the use of specific data sources for the web enabled surveillance and monitoring tool.

vii. Quarterly (December, March, June, September) research progress status reports from the program manager aviation maintenance human factors to the Aviation Maintenance TCRG representative.

viii. Annual Report: Grantee will submit an annual report using AAR-100's Productivity Report website http://www.hf.faa.gov/report/

b. Year 2: Develop Prototype Auditing and Surveillance Tool

Output from Year 1 activities will guide in the development of the prototype. The surveillance tool will incorporate the impact variables identified from Year 1 activities as input to the data collection, data reduction and data analysis modules. It is anticipated that collection and analysis of error data on the selected variables will lead to the identification and isolation of specific problem areas. This stage will use a software life cycle development methodology.

i. Collect Data: Collect data from maintenance personnel in using the existing paper prototype through interviews, focus groups, observing the paper prototype product in use, naturalistic

observation and by studying documentation. The output will be a detailed task description and a task analysis in the use of the existing system.

ii. Identifying Customer Needs: This step will try to establish maintenance personnel need for the use of web-based tool by analyzing data from maintenance types. Organize the needs into a hierarchy identifying primary, secondary and tertiary needs outlining the importance of the needs.

iii. Develop User Requirements and Usability Requirements: Based on the needs and profile of the users, task analysis, constraints and interface design principles the development team will outline the user requirements and the usability requirements for the web based tool.

iv. Product Specifications Phase: The product specification phase will outline the functional specifications, usability specifications and detailed design specifications.

v. Prototyping and Construction Phase: The following activities are involved as part of prototyping and construction: (1) Develop low fidelity prototypes using alternate architectures. (2) Evaluate the prototypes using experts and user interaction. (3) Select product concept(s) from alternatives. (4) Test the product concepts with users and set final specifications.

vi. Design Stage: The final specification and selected prototype will be converted into a usable product. Specific activities involved will be developing, coding, debugging and user testing. Focus will be on developing a functional and usable product based on good principles of human computer interface design and continual testing with user groups (maintenance personnel from team partner facilities).
    - The Federal Aviation Administration will own the source code.
    - Documentation of all associated source code will be available.
    - The prototype application will be developed in cooperation with our team partner (FedEx).

vii. Once developed the prototype application will be made available to maintenance community so that each maintenance entity can download the software from FAA's web site and implement it for their unit.

viii. Testing and Refinement Stage: In the testing stage the beta software will be beta tested by the team partner(s). Feedback emanating from this testing will be incorporated so that the software meets design specifications, usability goals and user experience goals.

ix. Implementation Phase: This stage will implement the system for users. Demonstrate use of tool by collecting sample data at user site(s).

x. Deliverable: The tool developed at this stage will enable the user to collect and reduce error data for identified set of impact variables. It will assist in performing basic trend analysis that helps the analyst in identifying problem areas to mitigate the ill effects of the errors.

xi. Quarterly (December, March, June, and September) research progress status reports from the program manager aviation maintenance human factors to the Aviation Maintenance TCRG representative.

xii. Annual Report: Grantee will submit an annual report using AAR-100's Productivity Report website http://www.hf.faa.gov/report/

c. Year III

i. Develop Advanced Data Analysis Module: Researchers will evaluate the potential for enhancing the data analysis module developed in Year 2 to include more advanced analysis (e.g., multi-variate analysis, risk assessments). This module will enable the analyst to conduct advanced analysis of select data sets to identify problem areas and will form the first step to conducting risk assessments.

ii. Validation Phase: Field data will be collected to determine whether the tool enhances the oversight of maintenance using the data reduction and analysis modules and assists the analyst in conducting risk assessments.

iii. Quarterly (December, March, June, and September) research progress status reports: from the program manager aviation maintenance human factors to the Aviation Maintenance TCRG representative.

iv. Annual Report: Grantee will submit an annual report using AAR-100's Productivity Report website http://www.hf.faa.gov/report/

3. Deliverables:

a. Year I:

i. Report identifying the list of impact variables to be used.

ii. Report on identifying the limitations and use of specific data sources for use in the auditing and surveillance tool.

b. Year II:

i. Report on the final design specifications.

ii. Report on the development process that was used in developing the web based tool. Results of data collection using the web based tool.

- Deliver the tool that included the data collection and reduction modules by December 2005.

- The Federal Aviation Administration will own the auditing/surveillance tool source code.

c. Year III:
   i. Deliver the prototype tool that incorporates the trend analysis module.
   ii. Report providing guidance and recommended practices in using the auditing/surveillance tool for oversight of maintenance.
   iii. Deliver final auditing/surveillance tool source code and documentation

4. Schedule:
   a. Year I Tasks: FY03/FY04
   b. Year II Tasks: FY04/FY05
      i. Deliver Web Based Tool with Data collection and reduction modules (September 2005)
   c. Year III Tasks: FY06
      i. Final Report and source code delivered with all modules (September 2006)

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